I. C. 6940 APRIL 1937

DEPARTMENT OF THE INTERIOR

UNITED STATES BUREAU OF MINES
JOHN W. FINCH, DIRECTOR

INFORMATION CIRCULAR

MINING METHODS AT THE CARSON HILL MINE CALAVERAS COUNTY, CALIF.

RECEIVED
MAY 11 1937
O. S. U. LIBRARY

BY

JOHN A. BURGESS

IF THIS REPORT HAS SERVED YOUR PURPOSE AND IF YOU HAVE NO FURTHER NEED FOR IT, PLEASE RETURN IT TO THE BUREAU OF MINES, USING THE OFFICIAL MAILING LABEL ON THE INSIDE OF THE BACK COVER.

Generated on 2024-09-18 02:43 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

CONTENTS

	Page
Introduction	1
Acknowledgment	1
History	1
Geology	2
Principal vein system	2
Bull vein system	2
Flat veins	3
Footwall veins	3
Calaveras vein	3
Physical characteristics of ore and enclosing rocks as related to the mining method	4
Schist ore bodies near Bull vein	4
Flat vein ore bodies	4
Footwall ore bodies	4
Calaveras ore bodies	4
Methods of sampling	5
Methods of development and mining	6
General development	6
Morgan-Melones mine	6
Calaveras mine	7
Development details	7
Shafts and winzes	7
Drifts and crosscuts	8
Mining	8
Surface mining by glory holes	9
Surface mining by power shovels	9
Union pit	9
Calaveras pit	10
Open stoping with casual pillars	10
Shrinkage stoping	11
Cut-and-fill mining	11
Drawing old fills	11
Square-set shrinkage stopes with subsequent filling	12
Underground transportation	12
Morgan mine	12
Calaveras mine	13
Percent extraction in mining	13
Ventilation	13
Fire hazards	14
Safety methods and first-aid training	14
Costs	14

Generated on 2024-09-18 02:42 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

FIGURES

Figure		Following page
1	Property map and principal workings . . .	2
2	General geology	2
3a	East-west section through Morgan-Melones shafts, showing principal ore bodies . .	2
3b	East-west section through Morgan-Melones	2
4	Longitudinal section Morgan-Melones mine	6
5	Longitudinal section of Calaveras mine. .	6
6	Headworks at the Melones shaft	8
7	Shrinkage stope from main level with Smith blockholing chutes	10
8	Smith block-holing chute	10
9	Shrinkage stope from intermediate level with bulldozing chambers	10
10	Cut-and-fill stope	10
11	Square-set shrinkage stopes with subsequent filling Calaveras mine	10

Generated on 2024-09-18 02:45 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

. C. 6940
pril 1937

INFORMATION CIRCULAR

DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

MINING METHODS AT THE CARSON HILL MINE, CALAVERAS COUNTY, CALIF.1/

By John A. Burgess2/

INTRODUCTION

The Carson Hill mine of the Carson Hill Gold Mining Corporation is at elones, Calaveras County, Calif. It is one of the numerous mines on the other Lode of California. The property extends for 8,400 feet along the trop of that important vein system. The elevation at the haulage level about 1,000 feet above sea level.

ACKNOWLEDGMENTS

Acknowledgment of assistance in the preparation of this paper is made Frank Wagner, underground superintendent; Max Petersen, engineer; and mer Mann, assistant engineer. The geology of the Mother Lode has been scribed by Adolph Knopf in Professional Paper 157 of the United States ological Survey; references to general geology have been abstracted large- from Knopf.

HISTORY

Gold was first discovered in Carson Hill district in August 1848 by Jim rson while prospecting with a group of fellow veterans of the Mexican War. ey found rich placer gold in the gravel of Carson Creek on the northern edge what is now the Carson Hill property. Later, John Hance traced this gold its source on Carson Hill and located the Morgan mine, which was owned d operated afterward by James G. Fair. Very rich ore was mined. In 1854 lump of gold was found that weighed 195 pounds troy and was valued at 3,534.

A description of early operations on Carson Hill is given in Mineral Re- rces of the United States for 1868. At that time the operating mines on rson Hill were the Morgan, Reserve, South Carolina, and Stanislaus. An glish concern, the Calaveras Consolidated Mines Co., Ltd., mined on the laveras vein from 1888 to 1893. The Melones Mining Co. operated the

---

1/ The Bureau of Mines will welcome reprinting of this paper provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Information Circular 6940."

2/ General superintendent, Carson Hill Gold Mining Corporation, and one of the consulting engineers, U. S. Bureau of Mines.

Generated on 2024-09-18 02:43 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Reserve mine from 1898 to 1918. The ore was treated in a 100-stamp mill an cyanide plant. These properties were acquired by the Carson Hill Gold Mine Inc., between 1918 and 1920 and were operated continuously until December 1926. During this period 1,073,161 tons of ore were mined. The recovery was $6,895,062, and the net operating profit was $1,624,481. Operating costs during this period were about $5 per ton. The production from Carson Hill to 1926 is estimated at $20,000,000.

The property (fig. 1) was idle from 1926 to 1930, when it was taken over by the Carson Hill Gold Mining Corporation, the present owners. Minin and milling operations were resumed in 1933.

GEOLOGY

The generalized geology of Carson Hill is shown in plan and section in figure 2. The ore bodies are in Calaveras sediments of Carboniferous age. The sediments are highly metamorphosed and stand steeply on edge, with a strike of N. 40° W. They consist principally of chlorite schists, amphibolite schists, and black phyllites. Dikes of ultrabasic rocks, such as gab and peridotite were intruded through this group of schists; the basic rock are now almost wholly altered to serpentine. Some small areas of apparently unaltered gabbro can be seen on the west slope of Carson Hill. Most of these rocks, however, are highly metamorphosed and schistose.

The geology is very complex; detailed mapping of the area is made diff cult by leaching, the formation of large masses of carbonates, and other f of alteration of the rocks. Ankerite and sericite are abundant. Often on type of rock seems to fade out into another.

Principal Vein Systems

Bull Vein System

This vein extends with more or less continuity from the northern part of the property, where it is known as the Bull vein, to the souther bounda where its extensions are known as the Stanislaus and Adelaide veins (fig. The part known as the Bull vein is the most important. In the Morgan and Melones mines, where ore is found, the vein is in a narrow belt of sericit schist. Crosscuts into the footwall usually encounter, in order, schist carbonatized rocks, such as ankerite, and serpentine or slaty schist. The vein is of solid quartz, banded in places, and is of low grade. In the Mo mine the quartz attains a width of 50 feet. The dip is 50° to 60° to the

The ore bodies of the Bull vein system (figs. 3A and 3B) are not in t quartz vein itself. They consist mostly of mineralized schist that lies a jacent to the hanging wall or the foot wall of the quartz; the ore bodies range in width up to 30 feet and more. One shoot of this kind, known as t hanging-wall ore body, was mined continuously from the surface to a depth 4,550 feet. The best ore showed a little graphite. The mill heads from t ore body averaged $14 per ton during 1919 and $11 per ton during 1920 (gol at $20.67 per ounce).

Generated on 2024-09-18 02:47 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 1.—Property map and principal workings, Carson Hill Gold-Mining Corporation, Melones, Calif.

Generated on 2024-09-18 02:42 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-18 02:42 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

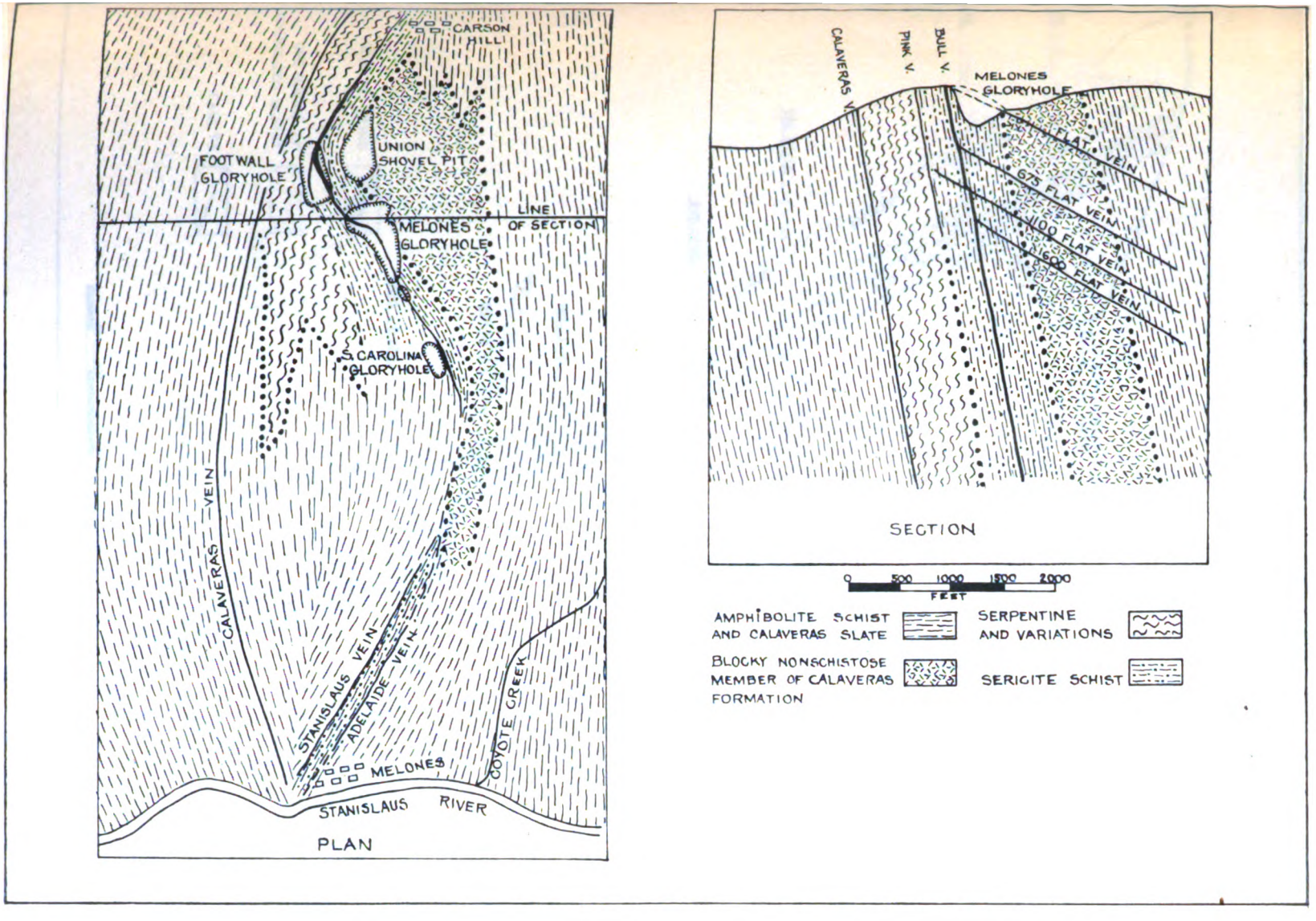

Figure 2.— Generalized geology, Carson Hill Gold Mine, Melones, Calif.

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

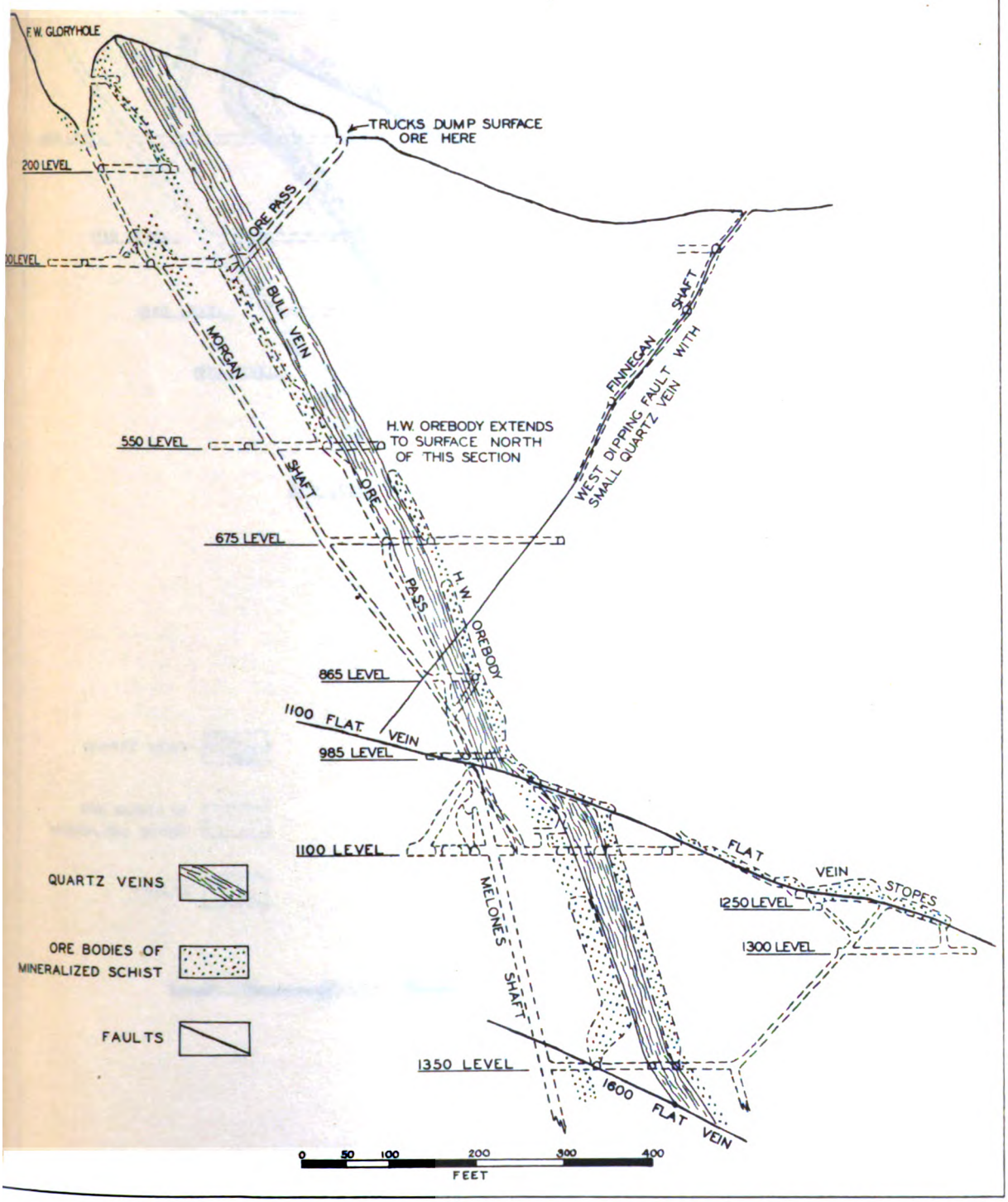

Figure 3A.—East-west section through Morgan-Melones shafts showing principal ore bodies. Carson Hill Gold-Mining Corporation, Melones, Calif.

Generated on 2024-09-18 02:41 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

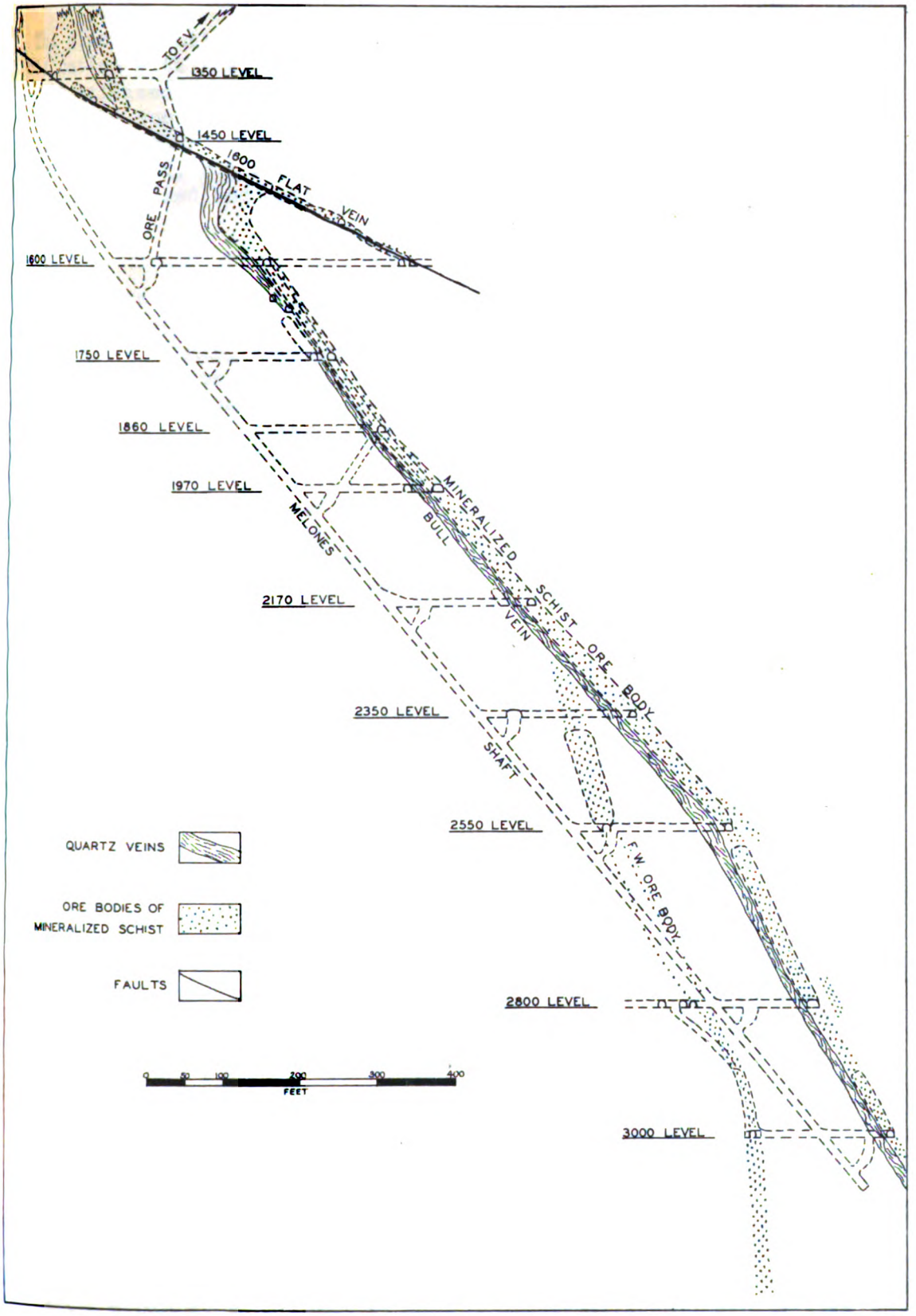

Figure 38.—East-west section through Morgan-Melones shafts showing principal ore bodies. Carson Hill Gold-Mining Corporation, Melones, Calif.

Generated on 2024-09-18 02:45 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
THE OHIO STATE UNIVERSITY

The mineralization of these schist ore bodies consists of a very light ilicification with the development of sericite and ankerite, 1 or 2 percent f partly oxidized pyrite, and traces of chalcopyrite and galena. Native old in minute specks can be seen occasionally, usually associated with the yrite. In the earlier operations in the hanging-wall ore body some very ich ore was found, but even in this the gold was not coarse. The schist s soft and oxidized and carries occasional quartz stringers.

Flat Veins

In addition to the schist ore bodies that parallel the Bull vein there as been developed a series of at least four "flat veins" (figs. 3A and 3B) hat lie on the hanging wall of the Bull vein fissure and dip 30° east. They ere formed by compressive forces, and the fissures are, therefore, thrust r reverse faults. They are later in origin than the Bull vein, which they ctually fault in some cases. In other cases they merely bend the Bull vein. hey are developed as lodes only in a hard blocky mass of rock that lies on he hanging wall of the Bull-vein channel. Quartz veins 2 to 8 feet thick ere developed in the fissures, and the adjacent rock was mineralized with oarse auriferous pyrite cubes for a variable distance from the quartz. n mining, both the quartz and the mineralized andesite are stoped. The aximum width of the ore was 40 feet.

Footwall Veins

The Pink vein system at the surface is a quartz vein and stringer lode ith mineralized schist that parallels the Bull vein for a short distance nd then diverges from it to the south. This vein system was the source of he high-grade ore found in the early days on Carson Hill. The 195-pound ugget came from this lode, and James G. Fair's operations were on it. lory-hole operations are still conducted on the vein, and some underground ining is done.

Most of the glory-hole ore is oxidized schist and ankerite, mineralized ith more or less oxidized pyrite and netted with quartz stringers. At the orth end quartz of later origin than the Bull vein predominates. Coarse old, associated with petzite (silver-gold telluride) is found occasionally n massive low-grade quartz of the Pink vein. A similar belt of mineralized chist with quartz stringers is being developed and mined on the 3,000-foot evel.

Calaveras Vein

The footwall member of the Mother Lode system in this mine is the alaveras vein (fig. 1). It passes through the entire length of the roperty near the western boundary and dips 60° to the east. The lode is a ranching and overlapping belt of parallel veins and stringers of white uartz interspersed with talcy gouge, talcose and sericitic schist, and asses of ankerite often streaked and stained green with mariposite. Single eins have a width up to 20 feet of quartz but usually they are narrower.

Generated on 2024-09-18 02:48 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

In the southern half of the property where the vein is now being mined, the hanging wall is a fairly firm, slaty schist, and the footwall is a talcy sch that grades into serpentine.

The ore occurs in shoots from 100 to 300 feet long. In much of the ore the gold is in the quartz, but in the oreshoot that is being mined by power shovel the ore consists of schist and ankerite, with quartz stringers at th outcrop of the Calaveras vein. Where the schist is valuable it is lightly mineralized with fine pyrite. Both schist and quartz are of milling grade. The ore is soft with talcy schist and streaks of gouge; the pyrite mineraliz tion is about 1 percent. Such ore is being shoveled to a width of 85 feet.

The higher grade ore consists of quartz very lightly mineralized with pyrite and with less galena and chalcopyrite. No coarse gold is found in t vein.

Strike faulting, distributed unevenly through the lode, makes the grou heavy and causes considerable distortion of the ore bodies.

PHYSICAL CHARACTERISTICS OF ORE AND ENCLOSING ROCKS AS RELATED TO THE MINING METHOD

Schist Ore Bodies Near Bull Vein

The width of stopes is determined by assay values. In underground min the stopes are 15 to 30 feet wide; the schist is sufficiently strong to per mit shrinkage stoping. At the Union shovel pit the outcropping schist is being excavated to a width of 50 to 150 feet. There is no faulting, except at the intersections with flat veins.

Flat-Vein Ore Bodies

The walls are compact, blocky, nonschistose rock. Open stopes are us with casual pillars. Old stopes, 40 feet high, have stood open for more t 10 years.

Footwall Ore Bodies

These are like the other schist ore bodies. They are in firm schist are mined by shrinkage stopes.

Calaveras Ore Bodies

As previously noted, the ore bodies are parallel and overlapping in a belt of soft, talcy schist. The width of the softened zone in which the o occurs is 30 to 70 feet. While the main hanging wall of the lode is of firm slaty schist, the mineable ore usually is not adjacent to the hard ro so that stopes often have a heavy hanging wall and a swelling foot wall. ground absorbs moisture readily and is heavy.

Generated on 2024-09-18 02:46 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

In previous operations the Calaveras mine was not worked extensively underground and most of the old workings have collapsed. The reopening and development of the mine was undertaken only within the past year, and the methods of stope operation are still in an experimental stage. However, it is certain that shrinkage or cut-and-fill stoping methods cannot be used because of heavy ground. Also, the mining must be more selective than in the open cut.

As far as current development has exposed it, the ore underground is mostly in the quartz veins, which have mineable widths of from 5 to 20 feet.

In power-shovel pits at the surface the ore is excavated for the full width of the softened zone.

METHODS OF SAMPLING

The ore in the Morgan mine usually consists of mineralized schist with or without quartz. The schist is sampled if it contains an appreciable amount of pyrite. If the schist contains no appreciable pyrite the value usually is negligible. The appearance of the ore is a fair guide as to the necessity for sampling.

In drifts and crosscuts, grab samples are taken from cars each shift except when the headings are obviously in waste. Cut samples and occasional specimen samples are taken by foremen or superintendents as needed to check car samples. If car samples have shown appreciable assay values, the heading is cut-sampled at 5-foot intervals.

Car samples are taken by "grabbing" a double handful of ore from each car and throwing it into a powder box. Near the end of the shift the shift boss leaves a bag and a descriptive tag in the box, and the trammer fills the bag. Samples are assayed daily, and the results are posted in the underground office.

Cut sampling in drifts and crosscuts is done with a stoping machine when the back is being sampled, or with a chipping hammer when samples are being taken from the sides. The sample cuts are 4-1/2 inches wide and 1 inch deep. The sample is caught on a canvas spread on the floor. When the stoping machine is used, an ordinary cross-point drill of suitable length, operated at slow speed, is guided by the operator along the sample mark.

Satisfactory comparisons were obtained at the United Eastern, Oatman, Ariz., between this method of sampling and hand moiling. Samples were taken under the direction of the author across ore containing high-grade streaks.

Samples are taken from the drill cuttings in the stopes; the daily output is checked by grab samples from the cars. The walls outside of the stopes are sampled by drilling long test holes and saving the drillings. In shovel operations cut samples are taken across the face at intervals. In the Union

5232

Generated on 2024-09-18 02:47 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

pit a shovelful of ore is taken from each truckload, and the batch is quartered down to sample size each day.

The ore from the Calaveras mine receives additional sampling. As it is hauled past the assay office to the mill a shovelful is taken from each 8-ton car. Each trainload of 50 or 60 tons is represented by a separate sample, which is crushed and quartered down in the assay office.

Car samples are found to average higher than the millhead sample; a factor is calculated each month and applied to the results of the daily samples.

METHODS OF DEVELOPMENT AND MINING

General Development

Morgan-Melones Mine

The main entrance is through the Melones tunnel on the 1,100-foot level. The adit extends 5,000 feet from the portal to the main workings. The tunnel, 8 by 8 feet in cross section, is untimbered except for short distances where it passes through softened zones. The Morgan tunnel is a secondary entrance to the upper workings; it is used only for men and supplies on the 300-foot level. An inclined, untimbered shaft, extending from the 300-foot to the 1,100-foot level, is used only for men and supplies. Level numbers refer to depths below the outcrop on Carson Hill.

The main working shaft for levels below the 1,100-foot level is the Melones (fig. 4). The collar is in the Melones tunnel, 4,800 feet from the portal. The shaft extends to the 3,000-foot level; it has three compartments and was sunk in firm ground under the Bull vein at an inclination of 60°. Timbering was done with Port Orford cedar, and although this timber has been standing for 30 years it is still in a good state of preservation.

The shaft was sunk parallel to the dip of the vein, but the hanging-wall ore body, owing to a southerly rake, was 250 feet from the shaft on the 3,000-foot level. If extended, the shaft would have been 600 feet from the ore body on the 4,000-foot level. Partly for this reason and partly through a desire to follow down on the ore body, a secondary subshaft (fig. 4) was sunk in the ore body from the 3,000-foot level to the present bottom at 4,550 feet. An untimbered raise from the 1,100-foot haulage level to the surface is used as an ore pass.

Levels above the 1,100-foot level are at irregular intervals varying from 100 to 190 feet, while below that level the interval is 150 feet.

In earlier operations drifting was done mostly along the Bull vein, especially on the hanging-wall side, and crosscuts were driven to develop the flat veins. In current operations more attention is being given to development in the footwall area, where important ore bodies are being found.

Generated on 2024-09-18 02:45 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Figure 4.—Longitudinal section, Morgan–Melones mine, Carson Hill Gold-Mining Corporation, Melones, Calif.

Generated on 2024-09-18 02:42 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-18 02:47 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

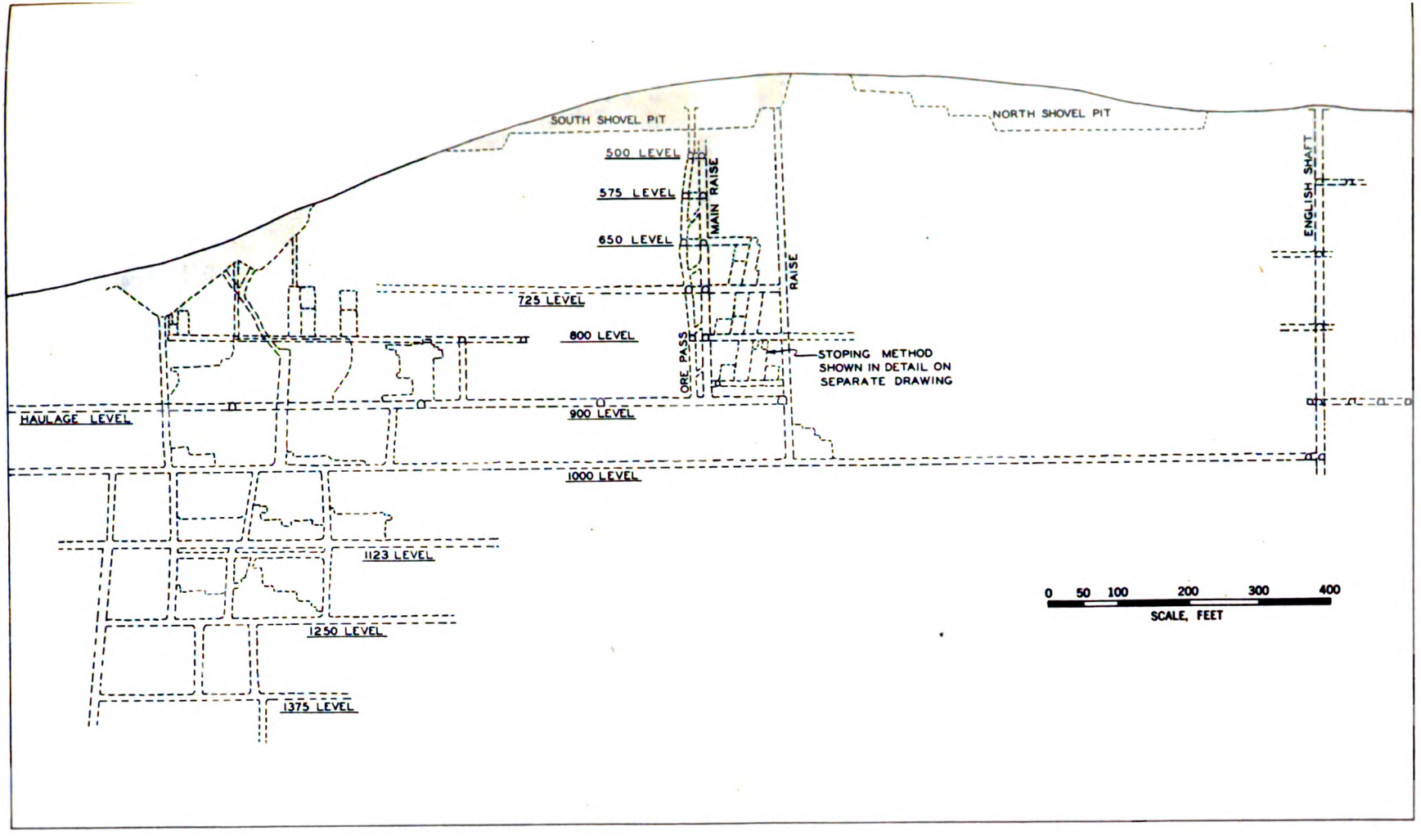

Figure 5.—Longitudinal section of Calaveras mine, Carson Hill Gold-Mining Corporation, Melones, Calif.

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

When operations were resumed in 1933, the Melones shaft had filled with water to the 2,500-foot level. Early in 1935 the water was bailed out to the 3,000-foot level, and development work was resumed there. At present water is being pumped from the subshaft with an air lift, so that development can be started on a new level 164 feet below the 3,000-foot level. Water is not a serious problem in this mine. Normally the amount to be raised is 8,000 gallons per day.

Calaveras Mine

The main entrance to this mine is an 8- by 8-foot haulage adit (fig. 1) at the elevation of the Melones tunnel. Because of a soft foot wall, the tunnel was driven in the harder rock of the hanging wall, where, parallel to the vein, it is about 50 feet from the soft lode material. Crosscuts were turned into the vein at intervals.

Old stopes that extended 100 feet above the tunnel level are tightly caved. In reopening this mine inclined twin raises were driven at an inclination of 60°, 15 feet apart, 400 feet to the surface (fig. 5), in the hard hanging-wall rock. One of these raises is a timbered hoistway for men and material, and the other is untimbered and is used as an ore pass. Cross inclines at intervals of 75 feet, connecting these raises, were used during the progress of the work to divert broken rock from the manway raise to the ore pass, so that all rock from both headings was drawn through the ore pass. The manway was served during construction by a small single-drum electric hoist and cage, which is now used for men and supplies.

Crosscuts connecting with both the manway and the ore pass were driven from the raise through the vein at 75-foot vertical intervals; drifting was then started from the crosscuts. After the drifts had been extended about 100 feet, short square-set stopes were started in ore, so that, when completed through to the next levels above, they could be used to store any waste that would be produced in further development. This work is now in progress. All drifts in the Calaveras vein are timbered.

At a point 350 feet south of the twin raises a two-compartment raise and ore pass was driven 100 feet to reach an elevation above two old stopes. After 400 feet of drifting to the south, square-set stopes were started on a quartz ore body 20 feet wide.

DEVELOPMENT DETAILS

Shafts And Winzes

No shaft sinking has been done under the present ownership. The Morgan inclined shaft is in hard rock and requires no timbers, except to support the rails. The shaft is 800 feet deep. It was partly sunk from the 300-foot level and partly raised from the 1,100-foot level. The track is constructed of thirty-pound rails spiked to 6- by 8-inch timbers.

Generated on 2024-09-18 02:45 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

The Melones shaft is in firm ground but is partly timbered. Sills, posts, and dividers are used throughout; caps and overhead lagging are used where the ground is slabby. Most of the timbers are of Port Orford cedar. The shaft has two hoisting compartments and one compartment for ladder, pipes and electric wires. The headworks at the Melones shaft are shown in figure 6.

The 3,000 winze, which gave access to levels below the 3,000-foot level was sunk mostly in the hanging-wall ore body on the hanging-wall side of the Bull vein. It is a timbered, three-compartment shaft, not straight, and poorly constructed. As stoping progressed, inadequate pillars of ore were left to protect the shaft. These partly failed and, in the later operations of the former company, some of them were removed below the 3,5[illegible] foot level. The shaft was always a poor one, and excessive labor for maintainance was required; however, it is known to be in good condition down to the 3,500-foot level. In present operations it is planned to use it to the depth for exploration of the footwall area below newly found ore bodies [illegible] feet in the footwall from the shaft. The shaft is now being unwatered and the hoist is being overhauled for that purpose.

The hoist was under water for 6 years, but it was well-greased before the shut-down and, after being cleaned and overhauled, is found to be in good operating condition in spite of an appreciable amount of salt (NaCl) in the water. The 600 feet of electric cable that was submerged was ruined because of faulty sealing.

The Calaveras double raise has been described already. The hoistway raise was driven 6 by 8 feet and was timbered with 10- by 10-inch Oregon fir. The ore pass is 6 feet 4 inches by 4 feet inside the timbers.

Drifts And Crosscuts

These are driven approximately 5 by 6-1/2 feet in cross section; most of them are timbered. In soft ground, as in the Calaveras mine, ordinary drift sets of round, native-pine poles are used. The top and sides are lagged with slabs, with bridging under the lagging. The posts are set with a batter. In driving through old fills, spiling is driven ahead of the advance sets.

In swelling ground, by using light timbers, with lagging well-bridged and by picking back the swelling footwall, it is found that there is less breakage of timbers and less labor for repairs than when heavy timbers with tight lagging are used.

Drilling is done with Gardner Denver H 81 drifting machines using 1 1/4-inch hollow round steel with cross bits.

MINING

Owing to the numerous types of ore bodies, several different stoping methods are used - (1) surface mining by gloryholes, (2) surface mining

Generated on 2024-09-18 02:45 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

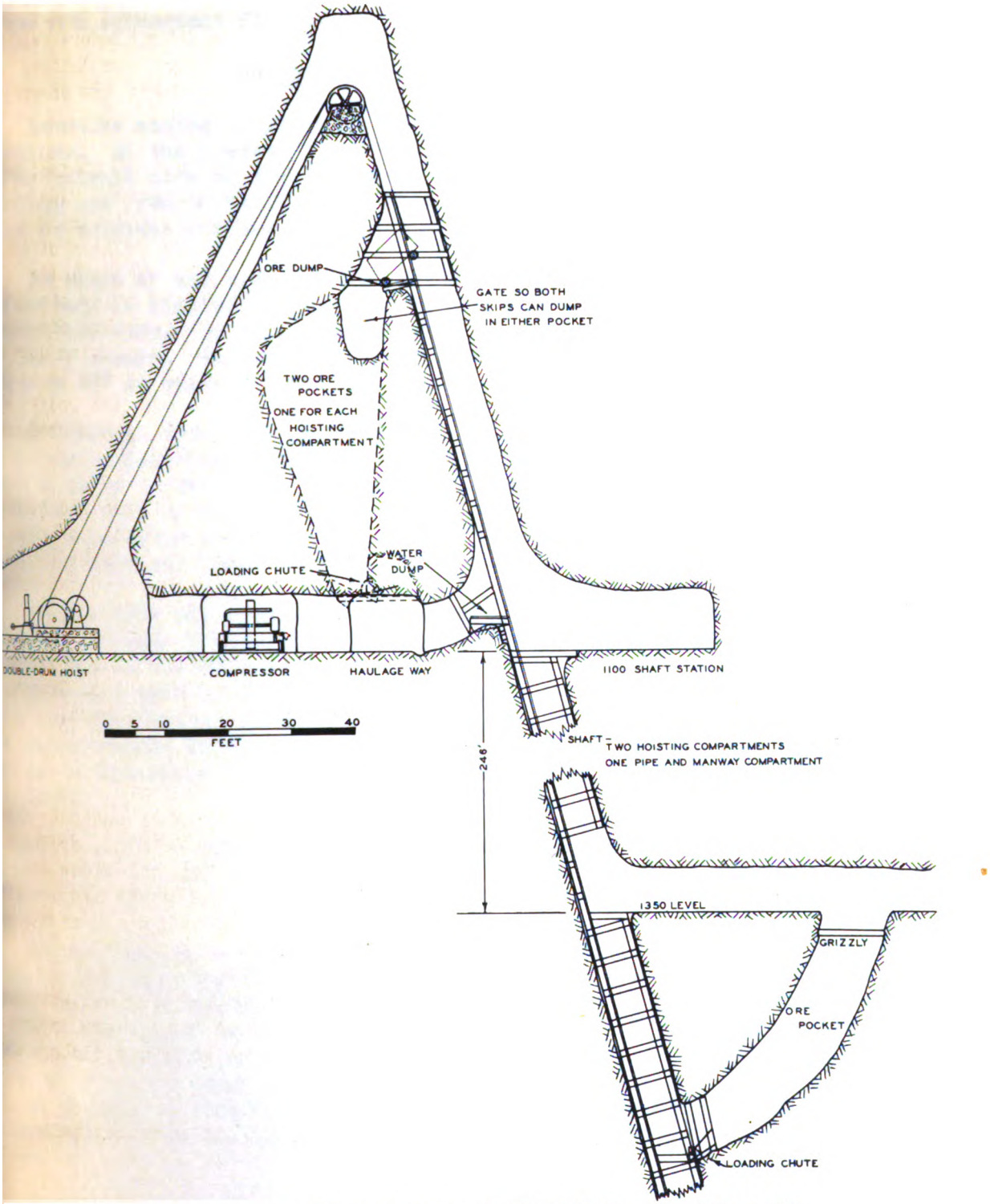

Figure 6.– Headworks at the Melones shaft, Carson Hill Gold-Mining Corporation, Melones, Calif.

Generated on 2024-09-18 02:46 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

ower shovels, (3) open stoping with casual pillars, (4) shrinkage stoping, 5) cut-and-fill stoping, (6) drawing old fills, and (7) square-set shrinkage topes with subsequent filling.

Surface Mining by Glory Holes

Extensive mining by glory holes was done on the property during earlier perations. At the present time only the Morgan glory hole in the Pink vein n the footwall side of the Bull vein is being worked. This is a cut 400 eet long and from 50 to 150 feet wide, the deepest part being 100 feet elow the original surface.

The shape of the ore body and consequently of the excavation is irregular. he ore body is limited on the east by the Bull vein, which tends to overang on that side. In other directions the extent of excavation is controlled by assays. The angle of slope ranges from almost vertical in some laces to 45° in others, depending on the nature of the rock.

Drilling is done with jackhammers, using drills up to 20 feet in length. o systematic pointing or spacing of holes is followed. The direction and epth of holes is determined by the character of the ground and by the form f the rock left by the previous blast. The longer holes are sprung with 0-percent gelatine and are loaded with 25-percent gelatine. The shots are ired with caps and fuse. Workmen use safety belts attached to long ropes.

The ore from the center of the glory hole (fig. 4) is drawn through mill oles to a 17-inch grizzly on the 200-foot level. A drag scraper is used to ove the ore to the mill hole at the north end. From the grizzly it passes hrough an ore pass to the 300-foot level, where it is trammed 100 feet in a -ton side-dumping car to the Morgan ore pass, which, in turn, delivers it to he loading chutes on the 1,100-foot haulage level. On north and south exensions of the glory hole the ore is hand-trammed to the grizzly on the 200oot level.

Surface Mining By Power Shovels

Union Pit

The ore body is a body of soft schist 400 feet long and 50 to 150 feet ide. It overlaps the old high-grade hanging-wall ore body and extends north f it. The ore is broken in benches 20 feet high. Holes 20 feet deep are rilled 8 feet apart in rows 12 feet or more apart. The holes are sprung nce with five sticks of 40-percent gelatine. The final charge is 50 to 100 ounds of black blasting powder, depending on the character of the ground. he row of holes is blasted at a time. Electric detonators are used; firing s done with a blasting machine. The cost of explosives is $0.022 per ton f ore.

The Bull vein, which forms the western or footwall limit of the ore body and pit, is not mined. The slope on the western face is about 50°. Up to the

Generated on 2024-09-18 02:43 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

present time the removal of very little overburden has been required on th eastern side of the pit, but as the work gets deeper this side will requir slope of 45° in oxidized rock or a steeper slope in hard rock.

A 1-cubic-yard gasoline shovel is used to load the ore into three tr which transport the ore to a 17-inch grizzly at the top of an ore pass. T ore pass delivers the ore directly to loading chutes on the haulage level after a drop of 800 feet. Many of the large pieces are broken by the fall considerable comminution of the ore results. The haulage distance is 20 300 yards. The trucks have a rated capacity of 2 tons each but are overlo to 3 tons. Two shovel scoopfuls fill each truck. One-hundred-thousand to of ore and practically no waste have been produced during the past year. average daily production is 500 tons of ore, except in the rainy season. operating force is one shovel operator, three truck drivers, and one or t drillers.

Calaveras Pit

The ore is 50 to 100 feet in width. It consists of a body of soft t schist and ankerite, with stringers and veins of quartz at the outcrop of Calaveras vein.

The ore is broken in benches 20 feet high. Vertical holes, 20 feet are drilled 8 feet apart in rows 10 feet apart. The holes are sprung twi first with one or two sticks of 40-percent gelatine powder and then with 10 sticks. The main charge is 75 to 100 pounds of black blasting powder each hole. Three rows of holes are shot simultaneously with an electric blasting machine. Explosives cost $0.069 per ton of ore.

Drilling is done with a "wagon drill" mounted on a frame with an au matic device to raise the drill and to lift the steel from the hole. Too holes are drilled when necessary to level the bottom of the cut.

In using the shovel, it is possible to mine selectively to some ext and included streaks of waste are moved to a waste dump. The vein dips 60° and a considerable amount of the overhanging wall is removed as wast The ratio of ore to waste is 4 to 1.

The angle of slope on the footwall side is about 60°, determined by dip of the schist formation. On the hanging-wall side the slope is irre varying from 45° to 80°, depending on the character of the formation.

Open Stoping with Casual Pillars

This method of stoping is used in the flat veins, where the walls a hard and stand well. The ore is either drawn directly through raises eq with grizzlies or is moved to the grizzlies and loading chutes by mechan scrapers. Large boulders are broken by block-holing. Widths up to 40 f have been mined.

Generated on 2024-09-18 02:46 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-18 02:46 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

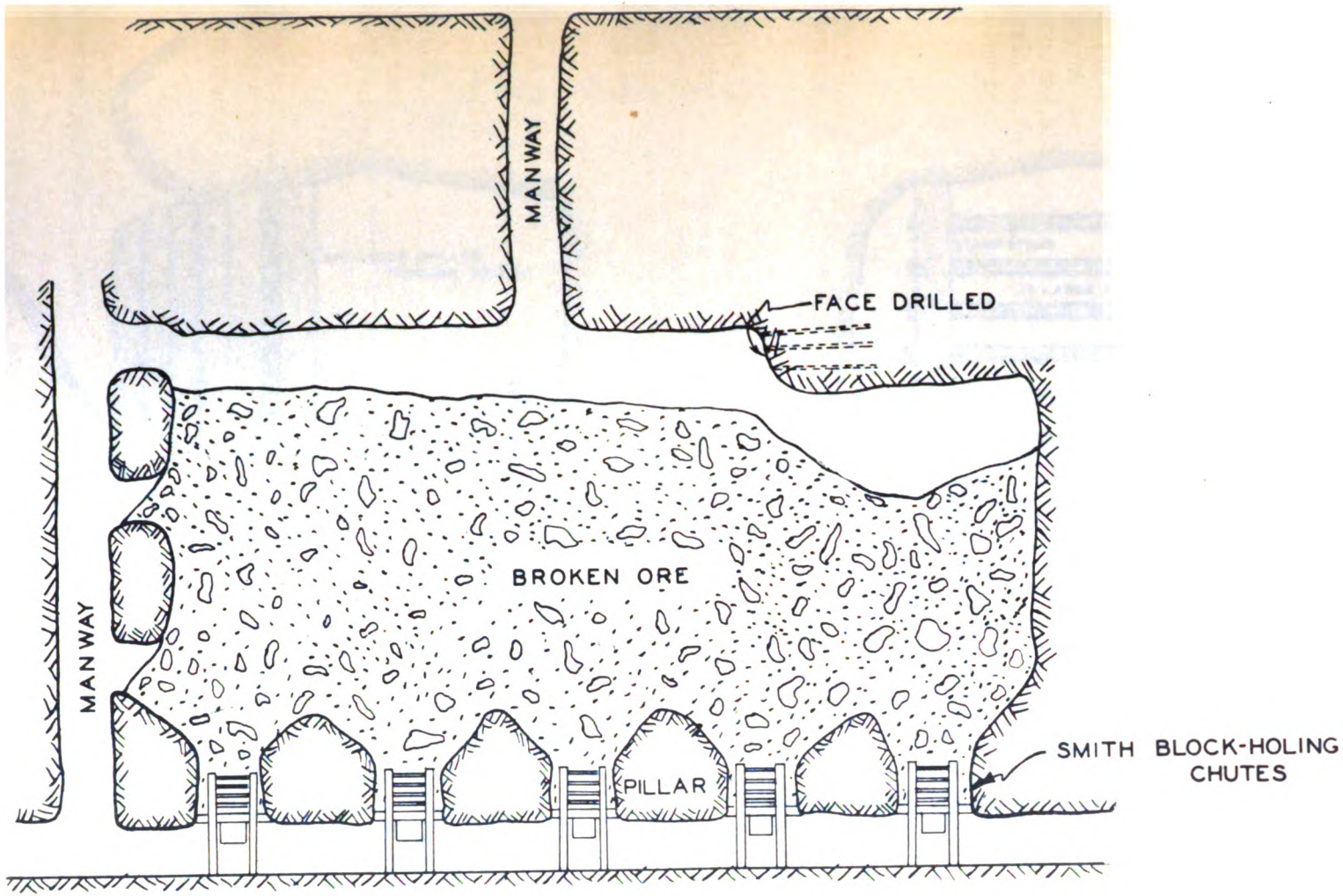

Figure 7.— Shrinkage stope from main level with Smith blockholing chutes, Carson Hill Gold-Mining Corporation, Melones, Calif.

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-18 02:42 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

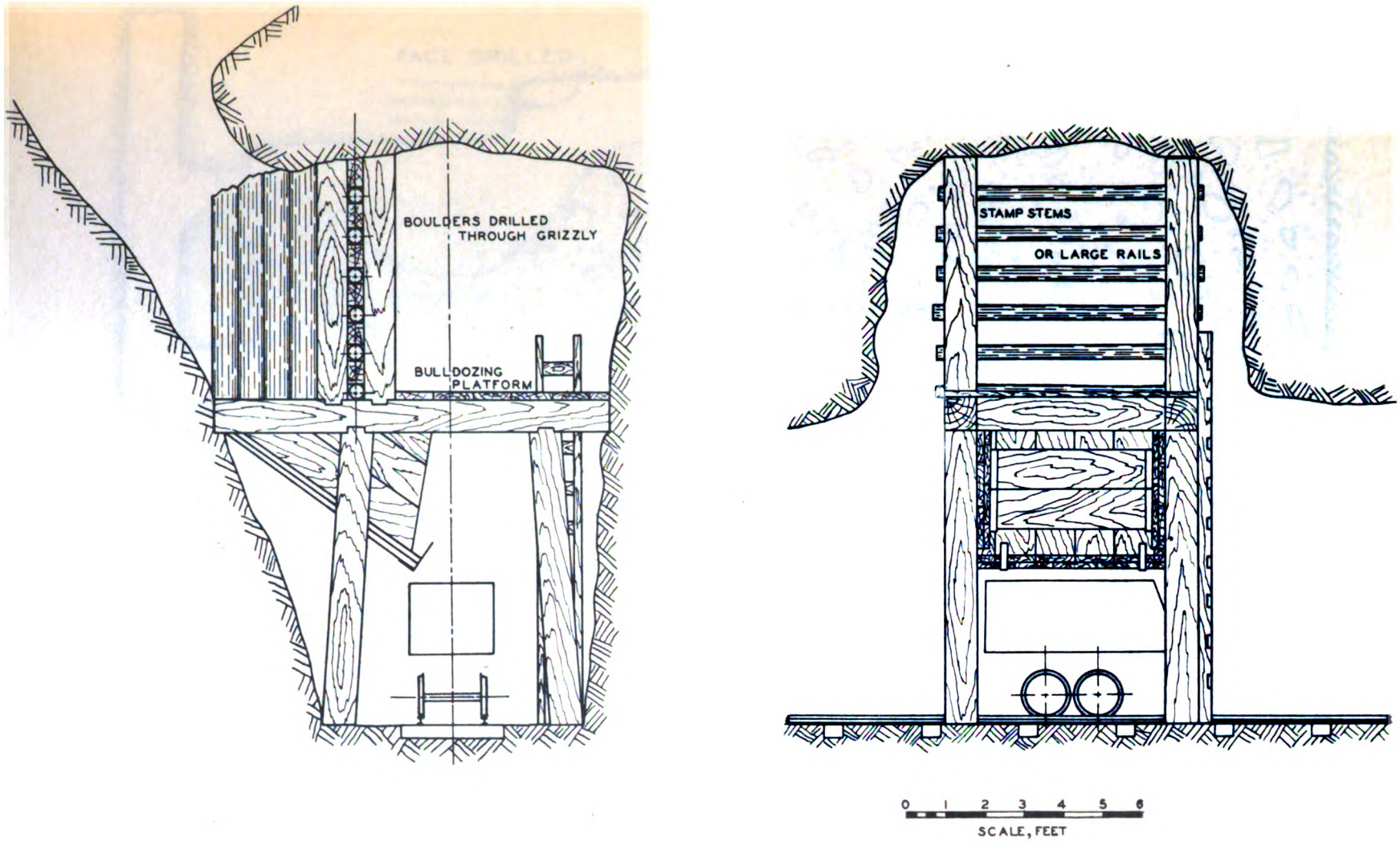

Figure 8.—Smith blockholing chute, Carson Hill Gold-Mining Corporation, Melones, Calif.

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-18 02:45 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Digitized by Google

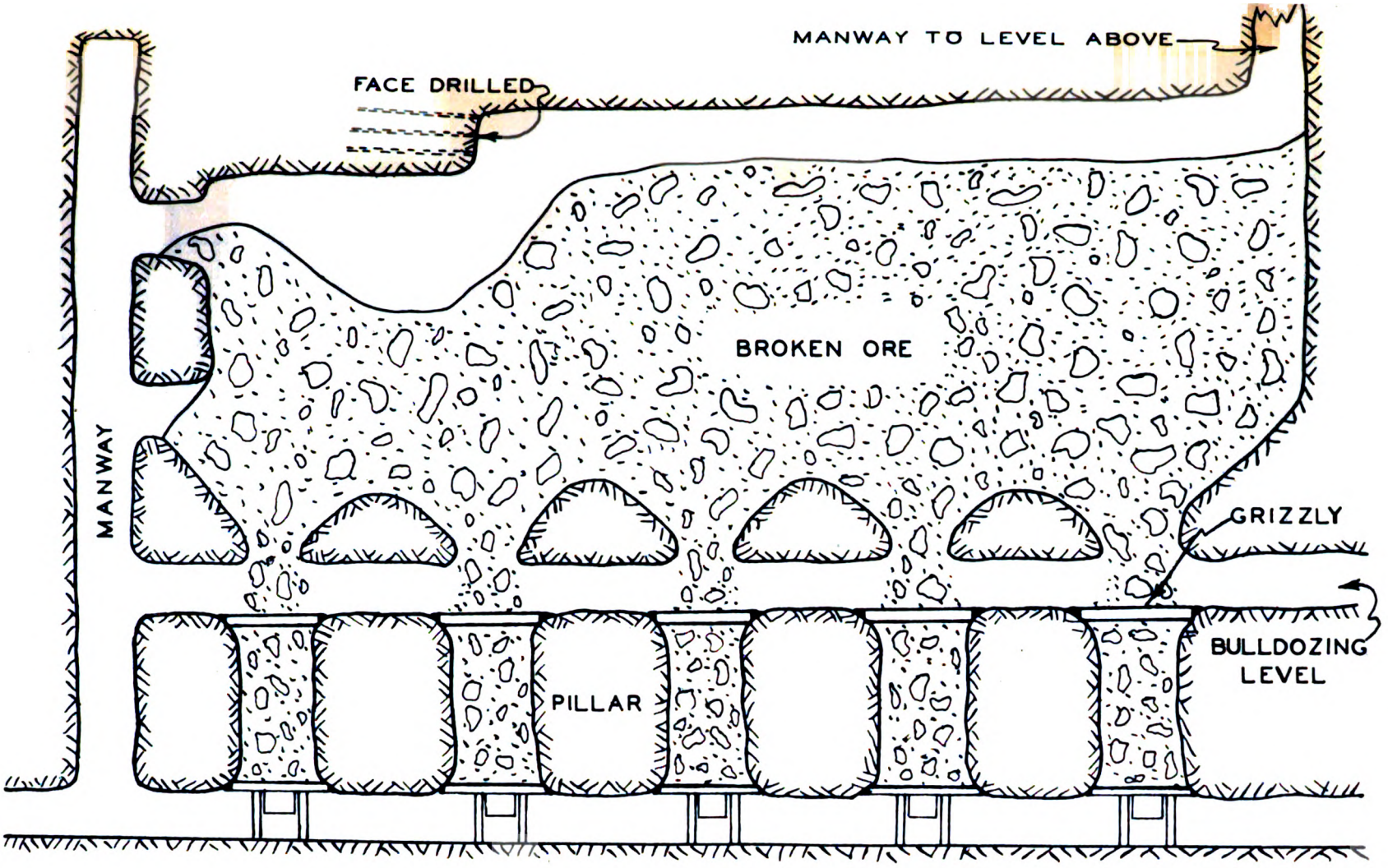

Figure 9.— Shrinkage stope from intermediate level, with bulldozing chambers, Carson Hill Gold Mining Corporation, Melones, Calif.

Original from THE OHIO STATE UNIVERSITY

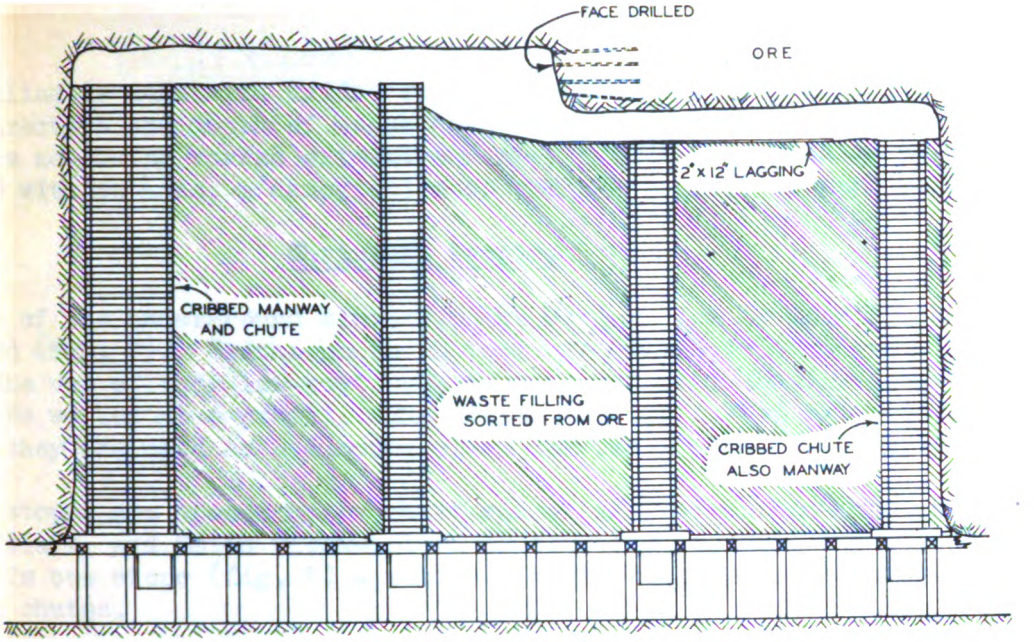

Figure 10.—Cut-and-fill stope, Carson Hill Gold-Mining Corporation, Melones, Calif.

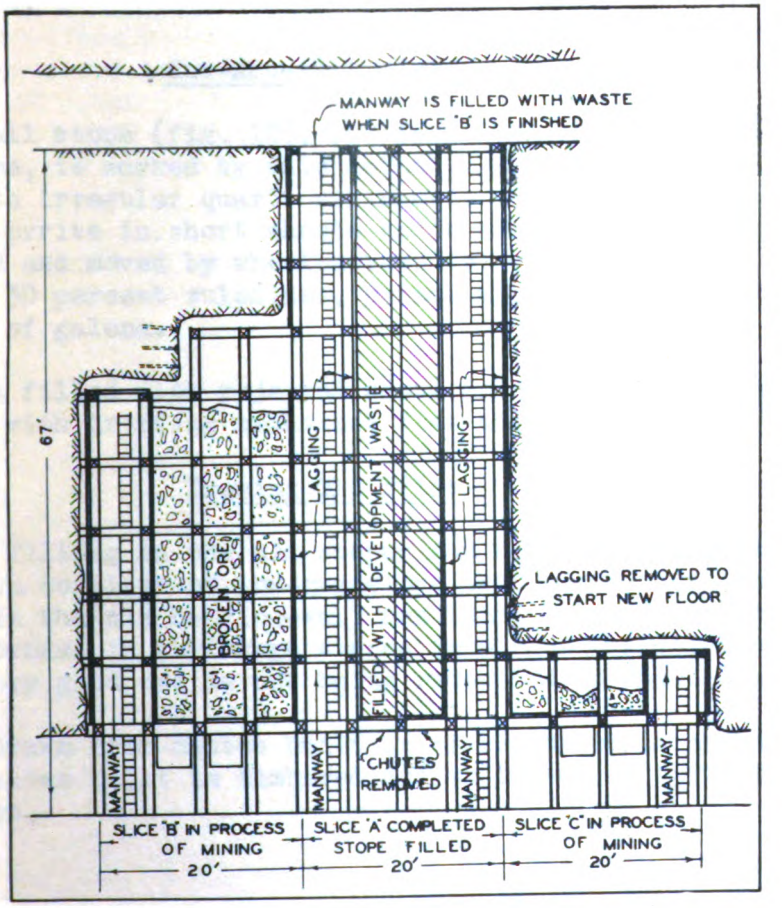

Figure 11.—Square-set shrinkage stopes with subsequent filling, Calaveras mine of the Carson Hill Gold-Mining Corporation, Melones, Calif.

Generated on 2024-09-18 02:46 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
THE OHIO STATE UNIVERSITY

Drilling is done with drifters. No systematic method of drilling is ed. Direction and depth of holes depends on the lay of the ground. These opes are not being worked extensively now, but as the paper is primarily ncerned with methods, a description of the system used appears pertinent.

Shrinkage Stoping

Most of the underground mining in the Morgan mine is done by the shrink- e method (fig. 7). Widths up to 30 feet are worked in this way. It is ly by the use of this low-cost method of mining that the low-grade schist es can be worked at a profit. The stopes are not filled systematically, though they are used as a dumping place for waste from development work.

The stopes are opened up by short raises at 25-foot intervals with inter- ning pillars, and Smith block-holing chutes (fig. 8) are built in the ises. In one stope (fig. 9) a sublevel with blasting chambers was driven ove the chutes.

The ore is broken by taking horizontal slices along the back of the ope. Drifting machines are used set up on bars. The holes are drilled at and 10 feet deep. Forty-percent gelatin powder is used and exploded th fuse and caps.

Cut-And-Fill Mining

Only one small stope (fig. 10), 100 feet long on the 3,000-foot level the Morgan mine, is worked by this method. The ore consists of black, aty schist, with irregular quartz stringers. The schist is heavily neralized with pyrite in short shoots and overlapping lenses and bunches. e ore is sorted and moved by wheelbarrows to cribbed raises. The sorted e carries 5 to 30 percent sulphides, principally pyrite, a little chalcopy- ite, and traces of galena.

The stope is filled with rejected waste and rock broken from the walls. filling is done with drifting machines; flat holes are used.

Drawing Old Fills

Most of the filling in the old stopes can be milled at a profit. Much of e material drawn consists of low-grade ore that caved from the hanging walls f the stopes. In the old hanging-wall ore body, caves from the hanging wall inched off ore broken in shrinkage stopes in places and interfered with awing. Some very good ore is now being recovered in these places.

The ore is drawn from chutes built in crosscuts or in drifts on the evels or from chutes built in timbered drifts driven by spiling through e filled stopes.

Generated on 2024-09-18 02:43 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Square-Set Shrinkage Stopes With Subsequent Filling

This method of stoping (fig. 11) is used in the Calaveras mine, where the walls are weak. The footwall consists largely of serpentinous schist with swelling gouge. The hanging wall is weak. Ordinary shrinkage stoping is out of the question.

Levels are driven 75 feet apart in the ore body. These are always timbered when they are in ore and elsewhere if necessary. Stopes 20 feet long and 1 to 4 sets wide are started and timbered with square sets. The sets are 5 by 6-1/2 feet. Light round poles 8 to 10 inches in diameter are preferred. Larger sizes are used only when the smaller sizes are lacking. The stope is kept full of broken ore as the work progresses, until the stope reaches the level above. The ore is then drawn out and is replaced with waste filling. Another similar stope is then started, adjoining the first one. By this method end slices are taken from the ore. The short stopes are driven through quickly, and the light timbers are sufficient to hold the walls until the ore is drawn and the stope is filled. By starting these stopes before development is complete they can be used to store the waste from development. By taking these short-end slices it is necessary to hold only a short stretch of stope open at one time, and consequently the timbering can be of light-weight poles.

It had been planned to timber these short stope sections with stulls, with a continuous line of headboards, either filling the stope or letting it collapse. The system would then be a retreating one. This system would probably work satisfactorily in stopes up to 6 or 7 feet in width. However the greater and more variable widths required the more flexible system of square-setting.

The square-set method of stoping used is satisfactory. It is not difficult to draw the ore, and when the stope is drawn empty the sets and footwall are scraped clean by hand.

UNDERGROUND TRANSPORTATION

Morgan Mine

The main haulage level is 1,100 feet below the highest outcrop of the ore body. Ore from the higher levels is delivered to loading chutes through the Morgan ore pass. Ore from the lower levels, down to the 3,000-foot level, which is the deepest being operated at present, is trammed by hand to the Melones shaft and hoisted in 3-ton skips. When operations get under way below the 3,000-foot level, it will be necessary to transfer the ore 300 feet on the 3,000-foot level. If these operations become extensive it may be possible to eliminate the transfer by sinking a new shaft near the 3,000-foot level ore pocket. The loading chutes on the haulage level are built of timber, with steel arc-gates operated by a hand lever. Hoisting at the Melones shaft is done with a Wellman, Seaver, Morgan, 250-horsepower double-drum, electric hoist. The hoisting speed is 1,000 feet per minute for ore and 800 feet per minute for men.

Generated on 2024-09-18 02:41 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

The ore is hauled to the mill crusher bins, a distance of 1 mile, through the Melones tunnel. Hauling is done by electric trolley motor. A train consists of seven cars each loaded with 8 tons of ore. The cars are the center-bottom dump type and are built in the mine shops. The track is of 65-pound rail.

Calaveras Mine

The ore is loaded from ore passes into 8-ton cars through hand-operated arc-gates. A haulage motor, operated from a storage battery, is used to haul a train of three cars to the mill. No hoisting is done in this mine at present.

Ore trains from both mines pass through the mine yard, where they are directed by switches to the track to the mill. An electric signal indicates whether either of the trains is on the mill track. An electric signal in the Melones tunnel indicates whether the switch outside the tunnel is open or closed. This signal is situated so that the train can be stopped before it reaches the switch.

Before they reach the crusher bins the haulage cars pass over a platform scale and each car is weighed. The weight of each car is printed on a separate ticket by an automatic numbering device.

PERCENT EXTRACTION IN MINING

Since the ore bodies in the Morgan mine are limited in width by "assay walls," percentage of dilution cannot be calculated. The lower limit of the grade of ore that can be mined varies, depending on the situation of the stopes. No sorting is done except in the cut-and-fill stope on the 3,000-foot level, where about 60 percent of the rock broken is waste.

Stoping in the Calaveras mine is mostly on quartz veins, but the square-set system used obviates virtually all dilution.

VENTILATION

Natural ventilation gives adequate circulation of air in all workings above the haulage levels in both the Morgan and Calaveras mines. All these workings have connections with the surface.

In the Morgan mine below the haulage level is a natural circulation downward through the Melones shaft and then, controlled by doors, upward through raises, which also form a secondary exit for men. The temperature and humidity is low on all levels.

Coppus blowers are used in long drifts and occasionally in stopes where natural circulation is inadequate. Two of these are operated by compressed air and require 21 cubic feet of free air per minute compressed to 75 pounds pressure. The blowing capacity is 870 cubic feet through

Generated on 2024-09-18 02:46 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

1,000 feet of 12-inch pipe. Two other blowers for 14-inch pipe are operat by built-in, 5-horsepower, electric motors.

FIRE HAZARDS

Two crews of five men each were trained for rescue work by the Unite States Bureau of Mines. A crew captain trains substitutes as they are re- quired by shifts in employment.

Fire extinguishers are kept in the underground hoist rooms.

The greatest fire hazard to the outside buildings is grass fires in mer, and to avoid trouble from this source back fires are burned around t buildings early in the summer. Before the grass is dry enough to burn, f breaks 3 or 4 feet wide are hoed clear of grass around all buildings and also in strategic lines some 100 feet or more from the buildings. As soo as it is dry, the grass within these limits is burned under the supervisi of a trained crew furnished with knapsack tanks and force-pump spray nozz Fire hose attached to fire hydrants is also used to control the backfire. On slopes, the backfires are started at the highest point and allowed to burn downward as in this way the fire travels more slowly and is less dif cult to keep under control. In case of a regional grass and brush fire, backfire can be started from the edges of this burned area without endan the buildings.

All buildings are equipped with fire extinguishers. Fire hydrants a hose are maintained within reach of all buildings.

SAFETY METHODS AND FIRST-AID TRAINING

Meetings of a Safety Committee are held monthly. The committee cons of the general superintendent, mine superintendent, mining engineer, mas mechanic, mill foremen, and mine shift bosses.

All accidents which occurred during the preceding month are reviewed and new suggestions are considered. Each suggestion receives a serial nu and reports are made on suggestions carried out. A stenographer makes a port of the proceedings of each meeting.

A "suggestion box" is maintained to receive safety suggestions from employee, but few suggestions are received from that source.

COSTS

Table 1 shows the mining cost per ton of ore moved to the mill, whic cost includes development, mining, transportation to mill, fire and compe sation insurance, and surface expense attributable to mining work.

Generated on 2024-09-18 02:45 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Table 1. - Summary of costs, Carson Hill Gold Mining Corporation, October 1935 to June 1936

Tons ore mined and moved to mill) Total production, all methods 1/)	215,235
Labor and supervision	$0.64
Power	.04
Explosives	.13
Timber	.06
General supplies	.16
Compensation insurance	.05
Haulage to mill	.07
Assaying, engineering, fire insurance, miscellaneous	.04
Total	1.19

1/ Costs of different methods not kept separate in general account.

. - Summary of mining costs in units of labor, Carson Hill Gold Mining Corporation, October 1935 to June 1936

Tons of ore mined and moved to mill) Total production, all methods)	215,235
Man-hour per ton ore for mining and development, total labor underground	0.77
Average tons per man shift	10.3
Labor, percent of total cost of mining	53.8

Generated on 2024-09-18 02:43 GMT / https://hdl.handle.net/2027/osu.32435030644033
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY